Inventory of American beech trees resistant to beech bark disease at Seney NWR

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Introduction

Beech bark disease was first accidentally introduced to Nova Scotia on ornamental beech trees (*Fagus sylvatica)* imported from Europe in the 1890s. Since then, the disease has spread through much of the northeastern United States and was first found in Michigan in 2000 (McCullough et al, 2001). Beech bark disease is a complex where American beech trees (*Fagus grandifolia*) are first infested by the exotic beech scale insect (*Cryptococcus fagisuga*) feeding on sap in the inner bark (Houston, 1998; McCullough et al, 2001). A white wax covers the bodies of the scale insects (Figure 1), which gives beech barks disease its characteristic "white wool" appearance during heavy infestations (McCullough et al, 2001). The wounds and fissures from the scales provide entry for the fungus *Nectria* sp. to invade the tree; the fungus kills the inner tissue of the bark, which may lead to girdling of the tree and eventual death (Houston, 1998; McCullough et al, 2001; Koch, 2010). The beech bark disease complex can be summarized as

beech trees + scale insects + fungus → beech bark disease

(Houston, 1998). Beech root sprouts are common occurrences during beech bark disease infestation and tree death (McCullough et al, 2001).

Disease resistant trees account for approximately 1-5% of the total number of American beech trees (Koch, 2010). Resistance is likely due to bark structure and chemistry which makes it unsuitable for scale insect infestation (McCullough et al, 2001). Current suggested management for the disease involves removing infested trees and trees prone to infestation and leaving the disease-free, healthy-looking trees (i.e., healthy crowns and smooth, tight bark) (Koch, 2010).

Four northern hardwood stands are located within Seney National Wildlife Refuge (Northern Hardwood Research Area, Chicago Farm, Conlon Farm, and Wilderness Area). The purpose of this report is to set up a protocol to compile an inventory of American trees resistant to beech bark disease. Once the inventory is completed, the trees can be revisited over time to monitor if they remain resistant to beech bark disease.

Figure 1. Beech bark disease white scales on American beech tree bark.

Methods

Prior to field sampling, belt transect start points along field edges/roads and direction of transect (cardinal direction: N 0°, S 180°, E 90°, or W 270°) were established using aerial imagery in ArcGIS (Table 1). The 1998 aerial imagery was acquired from the Michigan Department of Natural Resources – Digital Aerial Imagery Archive of USGS Digital Orthophoto Quadrangles; the 1998 imagery was taken when deciduous trees were not leafed out, which allowed for a better distinction of the desired hardwood stands. The belt transect start points are spaced 150m (492ft) apart, which allows for a 100m (328ft) buffer between the 50m (164ft)-wide belt transects (Figure 2).

The inventory should be conducted between June and August, when trees are fully leafed out, and during dry conditions, which will allow for better identification of beech bark. At least two data collectors are needed to conduct the inventory: one to focus on running the transect while also looking for beech trees and the other to solely focus on finding beech trees within the belt.

At the transect start point, the pre-specified direction is found with a compass and the transect is walked; bearing should be re-checked as needed. While walking the transect, the data collectors will be looking for live American beech trees, >12.7 cm (>5 in) diameter at breast height (DBH), within approximately 25m (82ft) on either side of the belt transect center line (Figure 1). When a live American beech tree is found within the belt, data collectors should mark their location on the transect with a pin flag. The beech tree is marked twice with flagging and labeled appropriately (stand-transect-tree#, e.g., CHIF-t4-#2, indicates Chicago Farm stand, transect 4, tree #2). Other data collected for each tree include GPS location (decimal degrees, NAD83), DBH (measured to the nearest 0.1in), presence or absence of beech bark disease scales, vigor code (Table 2), crown class (1. dominant, 2. co-dominant, 3. intermediate, or 4. suppressed; Table 3), and any other notes, if necessary. If a beech tree has two stems at breast height, mark and label and measure DBH for both stems, but indicate in "notes" that the stems are from the same tree.

References

Houston, David R. 1998. Beech bark disease. In: Britton, Kerry O., ed. Exotic pests of eastern forests conference proceedings; 1997 April 8-10; Nashville, TN. U.S. Forest Service and Tennessee Exotic Pest Plant Council: 29-41.

Koch, J.L., 2010. Beech bark disease: the oldest "new" threat to American beech in the United States. Outlooks on Pest Management, 21: 64-68.

McCullough, D., Heyd, B., O'Brein, J.G., 2001. Biology and management of beech bark disease: Michigan's newest exotic forest pest. Michigan State University Extension Bulletin E-2746. Available online at http://msue.anr.msu.edu/uploads/files/e2746.pdf.

Table 1. GPS locations for belt transect starting point, direction transect is to be walked, and the approximate end of the transect based on aerial imagery and site visits. Stand codes: Hardwood Natural Research Area, HNRA; Conlon Farm, CONF; Chicago Farm, CHIF; Wilderness Area, WILD.

Stand	Transect	LatN	LongW	Direction	Approx. end
NHRA	t1	46.24089	-85.94407	W 270	conifers
NHRA	t2	46.23955	-85.94416	W 270	road
NHRA	t3	46.23820	-85.94425	W 270	road
NHRA	t4	46.23687	-85.94938	E 90	conifers
NHRA	t5	46.23552	-85.94889	E 90	conifers
CONF	t1	46.21850	-85.95878	E 90	conifers
CONF	t2	46.21721	-85.95782	E 90	conifers
CHIF	t1	46.20733	-86.00087	N 0	road
CHIF	t2	46.20982	-85.99127	E 90	road
CHIF	t3	46.20849	-85.98912	E 90	river/road
CHIF	t4	46.20710	-85.98937	E 90	river
CHIF	t5	46.20575	-85.98934	E 90	conifers
WILD	t1	46.23337	-86.23937	N 0	river
WILD	t2	46.23118	-86.23740	N 0	river to west

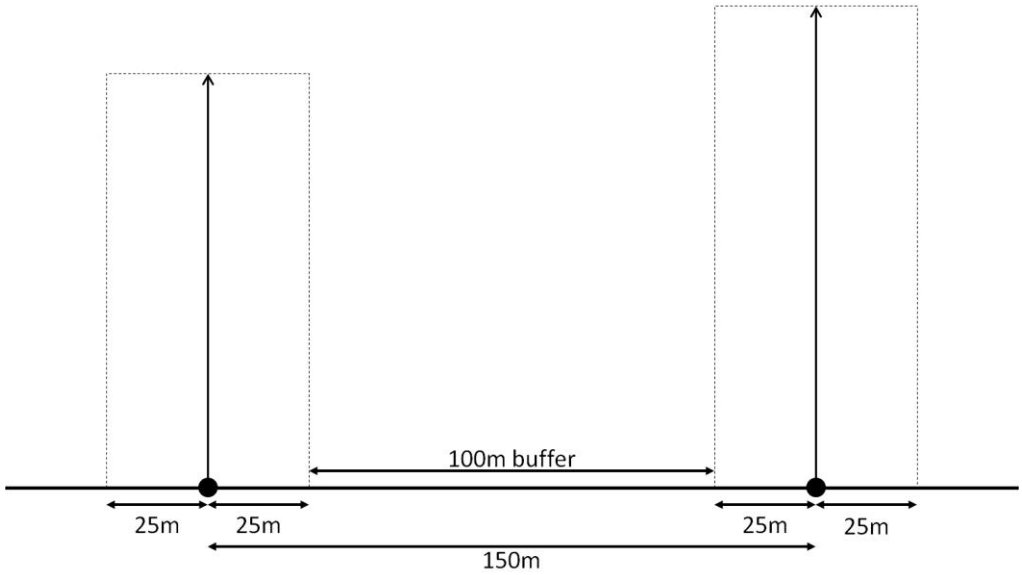


Figure 2. Belt transect layout for finding beech bark disease resistant trees. Transects run in one of the cardinal directions from the road or field edge.

Table 2. Tree vigor codes and criteria (from REA methods).

Vigor code	Criteria
1	Crown with relatively few dead twigs; foliage density and color normal; occasional small dead branches in upper crown; occasional large branch stubs on upper bole
2	Crown with occasional large dead branch in upper portion; foliage density below normal; some small dead twigs at top of crown; occasional large branch stubs on upper bole
3	Crown with moderate dieback; several large dead branches; bare twigs beginning to show; several branch stubs
4	Approximately half of crown dead
5	Over half of crown dead

Table 3. Crown classes (from REA methods).

1. Dominant – trees with crown extending above the general level of the crown canopy and receiving full light from above and partly from the sides. These trees are taller than the average trees in the stand and their crowns are well developed, but they could be somewhat crowded on the sides. Also, trees whose crowns have received full light from above and from all sides during early development and most of their life. Their crown form or shape appears to be free of influence from neighboring trees.

2. Co-dominant – trees with crowns at the general level of the crown canopy. Crowns receive full light from above but little direct sunlight penetrates their sides. Usually they have medium - sized crowns and are somewhat crowded from the sides. In stagnated stands, co-dominant trees have small-sized crowns and are crowded on the sides.

3. Intermediate – trees that are shorter than dominants and co-dominant. They receive little direct light from above and none from the sides. As a result, intermediate trees usually have small crowns and are very crowded from the sides. Intermediate trees may be short but as long as their bole is relatively straight, they will receive this designation. If the tree is crooked and has a lot of bends in the bole from trying to get light, it should be categorized as suppressed.

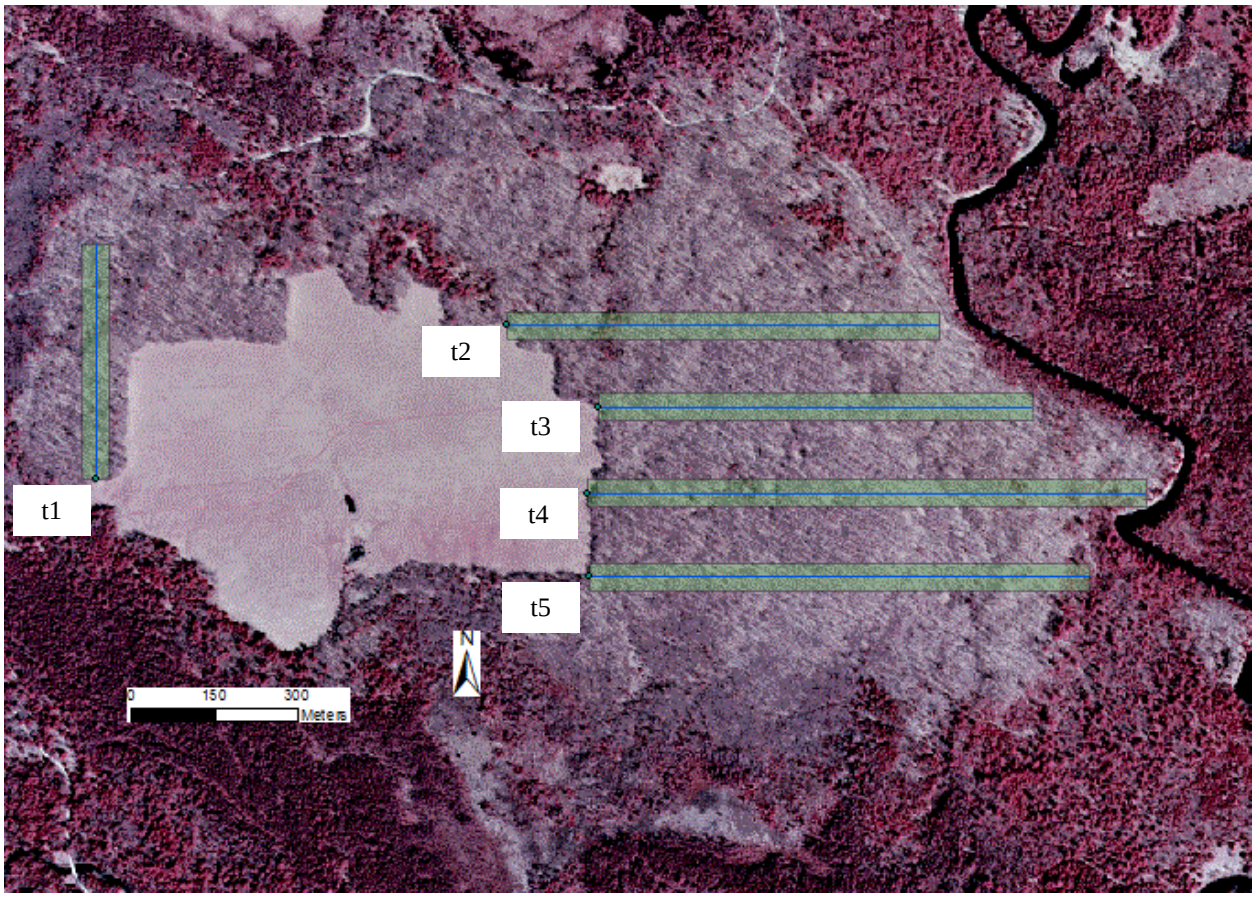
4. Suppressed – trees with crowns entirely below the general level of the crown canopy that receive no direct sunlight either from above or the sides. Suppressed trees usually have multiple bends in the bole for the tree as the tree grows toward light, and excessive side branching as well.

Equipment list

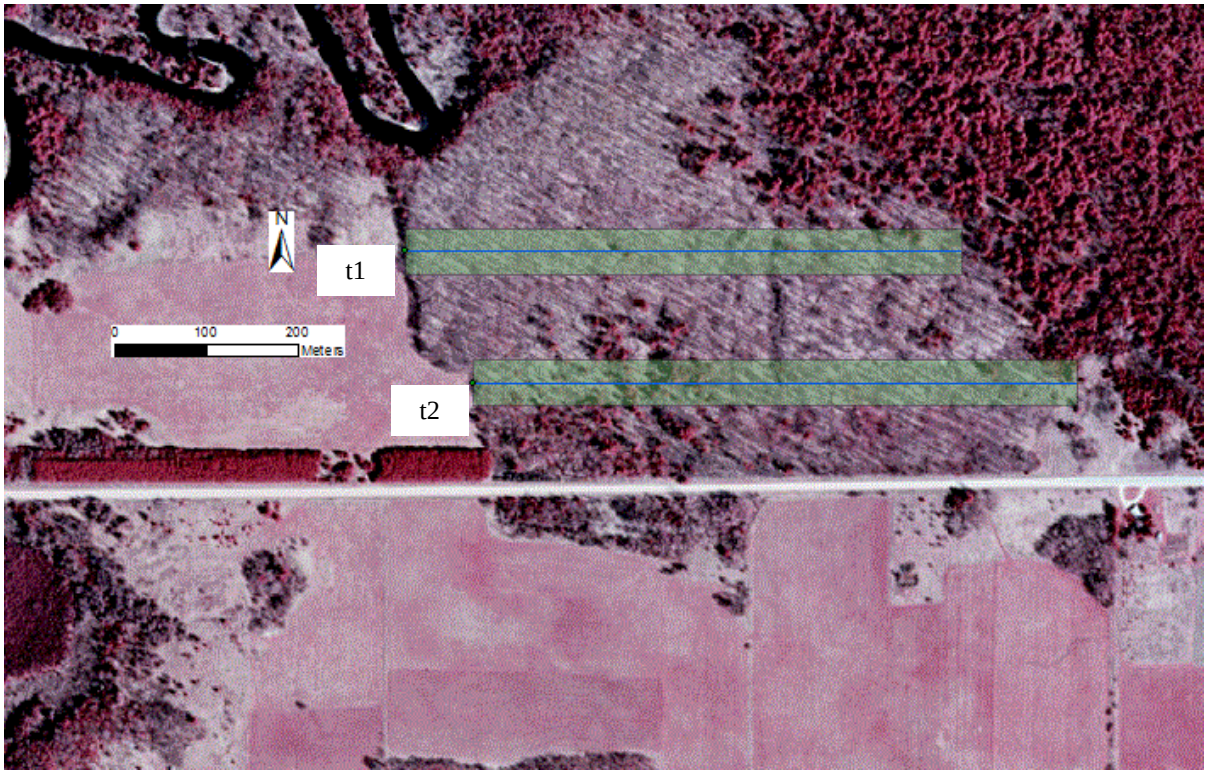
- GPS unit with transect start points
- Extra batteries for GPS unit
- Datasheets, vigor and crown class codes/criteria
- Clipboard
- DBH tape
- Pencils and Sharpies
- Flagging (pink or orange)
- Compass
- Field vest
- Pin flag (to mark location on transect when leaving center line)
- Binoculars (if needed to see tree leaves)

Stand transect layout

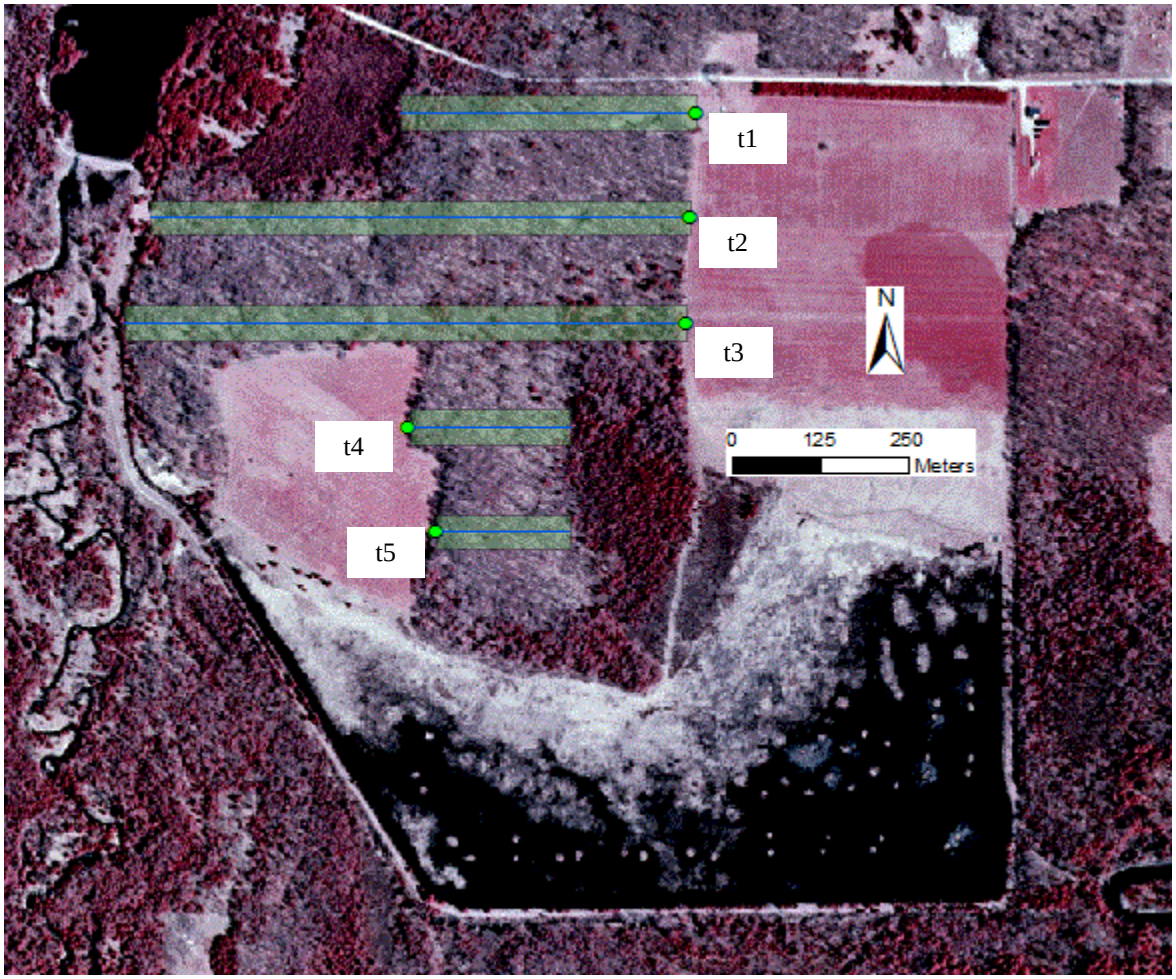
Chicago Farm (CHIF)



Conlon Farm (CONF)



Hardwood Natural Research Area (HNRA)



Wilderness Area (WILD)